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OF

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FOR

TELEPHONY SERVICES PROVIDER ARRANGEMENT FOR HOME AREA NETWORK

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INCORPORATION BY REFERENCE

U. S. Patent Application Serial No. 09/365,726, filed August 3, 1999, in the name of Richard Edson, entitled "Multi-Service In-Home Network With An Open Interface" and assigned to the assignee of this application, incorporated by reference.

U. S. Provisional Patent Application Serial No. 60/193,813, filed March 31, 2000, in the name of Theodore F. Tabloski, et al., entitled "Home Area Network" and assigned to the assignee of this application, incorporated by reference.

FIELD OF THE INVENTION

The invention relates generally to the field of user-premises or home area networking, to allow different types of systems and/or communications devices to utilize one in-home network to communicate with each other and to access a number of external communication services, and more specifically to systems and methods of connecting telephone sets to the public switched telephony network (PSTN) through a home area network, which can also provide other telephony services.

BACKGROUND OF THE INVENTION

U. S. Patent Application Serial No. 09/365,726, filed August 3, 1999, in the name of Richard Edson, entitled "Multi-Service In-Home Network With An Open Interface" (hereinafter "the Edson application") and U. S. Provisional Patent Application Serial No. 60/193,813, filed March 31, 2000, in the name of Theodore F. Tabloski, et al., entitled "Home Area Network" (hereinafter "the Tabloski, et al., application") describe various embodiments of an in-home

network and server therefor that provides a number of services. It is desirable to interface the home's telephony devices to the server to facilitate provision by the server of a number of telephony services, such as call answering and recording of messages, in such a manner so that, in the event of a power failure or malfunction of the server, the home's telephony devices will still be connected to the PSTN to facilitate receiving and placing of telephone calls.

SUMMARY OF THE INVENTION

The invention provides a new and improved system and method of connecting telephone sets to the public switched telephony network (PSTN) through a home area network to facilitate, inter alia, provision of a variety of telephony services.

In brief summary, the invention provides a telephony services provider arrangement for use in connection with a server in a home area network, the telephony services provider arrangement being configured to provide at least one telephony service in connection with at least one telephony device connected to the server. The telephony services provider arrangement comprises a telephone interface and a control module. The telephone interface is configured to, in a telephone link connected state, connect the at least one telephony device to a telephone link and, in a telephone link disconnected state, disconnect the at least one telephony device from the telephone link to facilitate provision of the at least one telephony service to the at least one telephony device. The control module configured to selectively control the telephone interface to (i) the telephone link connected state to facilitate receipt of incoming calls by the at least one telephony device, and (ii) the telephone link disconnected state to facilitate provision of the at least one telephony service to the at least one telephony device.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention is pointed out with particularity in the appended claims. The above and further advantages of this invention may be better understood by referring to the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 depicts a home area network including a telephony services provider arrangement providing an interface to the public switched telephony network (PSTN), constructed in accordance with the invention;

FIG. 2 is a functional block diagram of the PSTN interface useful in the home area network depicted in FIG. 1; and

FIG. 3 is a flow chart of operations performed by the PSTN interface in which the invention.

DETAILED DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

FIG. 1 depicts a home area network 10 including an telephony services provider arrangement that provides an interface to the public switched telephony network (PSTN), constructed in accordance with the invention. Generally, the home area network 10 facilitates the connection of a plurality of household appliances, devices, television and radio receivers, telephone sets, and other facilities (generally "devices") 11(1) through 11(N) (generally identified by reference numeral 11(n)) to a home server 12 over one or more digital communication links generally identified by reference numeral 13 and analog communication links generally identified by reference numeral 14. The home server 12 can also connect to a number of external connections, including a central office in the public switched telephony network (PSTN) over a PSTN link 23, a network such as the Internet over a network link 20, a cable connection (for use in providing cable

television, telephony, Internet and other services as will be apparent to those skilled in the art) over cable link 22, a compact disk player over a compact disk link 21, a barcode reader over barcode link 24, and perhaps other devices (such as devices providing information via satellite and the like, home security devices, and so forth) over other links generally identified by reference numeral 25.

As described in, for example, the aforementioned Edson and Tabloski, et al, applications, the devices 11(n) can transfer information among themselves over the respective communication link 13, 14 to which they are connected. In addition, the devices 11(n) connected to one communication link 13, 14 can transfer information to devices connected to another communication link 13, 14 and between the devices 11(n) and the PSTN, network, cable, etc., through the server 12; in that operation, if one device 11(n') is connected to an analog communication link 14 and another device 11(n") (n"≠n') is connected to a digital communication link 13, the server 12 can perform a digital to analog or analog to digital conversion as necessary. In addition, the server 12 operates to store information received from the PSTN, network, cable, and devices 11(n) for later transmission over the PSTN, network, cable, etc., and later transmission to the devices 11(n). The information transferred over communication links 13 is preferably in digital form, as is the information stored on the server. On the other hand, information may be transferred over other connections in digital or analog form as appropriate.

The devices 11(n) that can be connected to the home area network 10 can include a number of types of appliances, including but not limited to devices such as personal computers, personal digital assistant (PDA) devices, telephony devices (illustratively device 11(N)), and home entertainment devices such as radio and television receivers, DVD, compact disk, video and audio tape and record players, and the like. In addition, devices 11(n) that can be connected to the home area network can include lighting, heating and cooling, and similar systems, as well as appliances such as stoves and ovens. If a particular device is a "legacy" device, that is, a device that itself does not have an interface that can be connected to a digital communication link 13, that legacy device can be provided with a suitable interface to allow it to be so connected.

Generally, the home area network 10 operates to allow information to be stored on the server 12, transferred among the devices 11(n), and transferred from or to a number of external sources or destinations, including, for example, sources or destinations over a network such as the Internet or the public switched telephony network (PSTN), cable or satellite television or radio, music sources such as compact disks. The information may comprise any form of information, including, for example, audio information, image and video information, information in text form, control information for, for example, controlling one device from another or from the server 12 in relation to, for example, occurrence of certain events, computer programs, and so forth. The home area network can be used to, for example, transfer audio information from sources to destinations such as the server 12 for storage or to various devices 11(n) for playing. Similarly, the home area network 10 can be used to transfer image or video information from sources to destinations such as the server 12 for storage or to various devices 11(n) for display. In addition, the home area network 10 can be used to transfer control information to control controllable devices, such as lighting, appliances such as stoves and ovens, heating and cooling systems, alarm systems and the like.

The communication links 13, 14 may be in any form, including a hard link such as a wire, optical fiber or other arrangement for transferring electrical, optical or other signals among the appliances. Alternatively or in addition, communication links 13, 14 may comprise wireless links, such as but not limited to infrared links or links provided by signals in other parts of the electro-magnetic spectrum. Communication links 13, 14 may comprise communication links specially provided for the home area network 10, and/or they may include pre-existing links such as telephone lines, wiring provided for, for example, AC power distribution, and the like.

Each device 11(n) connected to a digital communication link 13 preferably includes or is provided with an interface (not separately shown) that enables it to transmit information, in the form of message packets to, and/or receive information in the form of message packets from each other and the home server 12 over the respective communication link 13. When a device 11(n) receives message packets containing information, it can use the information as described below.

Generally, the server 12 includes a number of components (not separately shown), including components for processing, storing and retrieving data in digital form, and for converting data between digital and analog form. With particular reference to the present invention, the server 12 also includes an interface 30 to the PSTN link 23 that facilitates connection of telephony devices thereto through the server 12. The telephony devices may be any type of devices that may make use of the PSTN and telephony services, including, for example, voice telephone devices, facsimile ("fax") machines, personal computers, and so forth, for placing and receiving telephone calls involving voice, fax and data communications. The server 12 provides a number of services, including, for example, automatic answering and recording of messages, providing a plurality of voice mailboxes, and the like. In addition, if a telephone call is received, the server 12 can provide a notification to any device 11(n) connected thereto, including, for example, a notification for display on a television receiver or personal computer that may be connected to a communication link 13, 14. If the telephone subscriber is also subscribing to the caller identification service, in which the PSTN provides the identification of callers, the displayed notification may also include the identification of the caller.

The telephone interface 30 provides an arrangement whereby the telephony devices connected to the server 12 are preferably normally connected to the PSTN link 23 so that, when a call is received, and if a user desires to answer it, he or she may do so. The telephone interface 30 also allows the server 12 to monitor the status of an incoming call so that, if the user does not answer the call, the server 12 may answer the call and record a message. In addition, if the user is also subscribing to the caller identification service, the server 12 can receive the caller identification information and display it along with the call notification as described above. On the other hand, the telephone interface 30 also provides an arrangement whereby the telephony devices can be disconnected from the PSTN link 23 to, for example, enable a user to listen to messages that have been recorded by the server 12, manage

messages, establish and manage voice mailboxes established on the server 12 to receive messages for various individuals, and otherwise manage telephony and other services provided by the server 12 using conventional telephony devices that are connected to the server.

FIG. 2 depicts a functional block diagram of a telephone interface 30 in accordance with the invention. With reference to FIG. 2, telephone interface 30 connects to the PSTN link 23 and to one or more telephony devices 31(1) through 31(N) (generally identified by reference numeral 31(n) over an analog communication link, identified in FIG. 2 by reference numeral 32. The telephony devices 31(n) can be any conventional telephony devices, and may include devices that dial using DTMF (dual-tone multiple-frequency) tones, dial pulses and the like. The telephone interface 30 includes a number of elements, including a selector switch 33, a modem 34, an RS232 converter 36, a ring detector 37, and a subscriber line interface card 41.

Generally, the selector switch 33, under control of signals from the server's processing components, controls the connection and disconnection of the communication link 32 and modem 34 to the PSTN link 23. When the selector switch 33 is in the PSTN link connected state, in which the communication link 32 and modem 34 are connected to the PSTN link 23, the telephony devices 31(n) can receive and place telephone calls over the PSTN link 23. In that PSTN link connected state, the modem 34 is also connected to the PSTN link 23 and, if the subscriber does not answer an incoming call, the modem 34 can answer the call, provide an "out-going message" to the calling party and, if the calling party leaves a message, receive the message and enable the message from the calling party to be stored on the server 12.

On the other hand, when the selector switch 33 is in the PSTN link disconnected state, in which the communication link 32 and modem 34 are not connected to the PSTN link 23,

the telephony devices 31(n) cannot receive or place telephone calls over the PSTN link 23. Instead, the communication link 32 is connected to the modem 34. In that condition, a user, using the telephony device 31(n) can control the modem 34 to enable the retrieval of previously recorded messages, record an out-going message, and control the various telephony services provided by the server 12. In that state, the communication link 32 and modem 34 are also connected to the subscriber line interface card 41, which can provide electric power to facilitate communication between the communication link 32 and modem 34. In addition, as will be described below, if another party attempts to place a call to the PSTN link 23, the ring detector 37 detects the ring signal that the telephone central office provides over the PSTN link 23 and provides a notification to the server's processor. The processor, in turn, can enable a notification that an incoming call is being received to be provided over the communication link 32, and the user can determine whether to take the call. If the user decides to take the call, he or she can enable the selector switch 33 to return to the PSTN link connected state. The selector switch 33 is under control of the server's processor, and may be transitioned from the PSTN link connected state to the PSTN link disconnected state, and from the PSTN link disconnected state to the PSTN link disconnected state in response to, for example, control codes input by a user through a keypad that is normally provided on a telephony device to facilitate dialing.

The selector switch 33 includes two switch sections 33C and 33M, both of which are controlled in tandem by the server's processing components (not separately shown). Each switch section is a double pole-double throw switch. Switch section 33C includes six terminals, including a terminal pair generally identified by reference numeral 33C(1) that connects to the wires comprising communication link 32 and a terminal pair 33C(2) that connects to the wires comprising PSTN link 23. Similarly, switch section 33M includes three terminals, including a terminal pair 33M(1) that connects to wires connected the modem 34 and a terminal pair 33M(2) that connects to wires connected to the PSTN link 23.

Terminal pairs 33C(3) and 33M(3) of the switch sections 33C and 33M are connected together and to the subscriber line interface card 41. Each switch section has a pole pair 33CP and 33MP that are affixed to respective terminal pair 33C(1) and 33C(2) and that can be selectively connected to respective terminal pair 33C(2), 33M(2) or 33C(3), 33M(3). When the pole pairs 33CP and 33MP are connected to terminal pairs 33C(2) and 33M(2), the selector switch 33 is in the PSTN link connected state and, when the pole pairs 33CP and 33MP are connected to terminal pairs 33C(3) and 33M(3), the selector switch 33 is in the PSTN link disconnected state. As noted above, the pole pairs 33CP and 33MP are controlled in tandem, with both pole pairs 33CP and 33MP being connected to respective terminal pairs 33C(2) and 33M(2) simultaneously, or to respective terminal pairs 33C(3) and 33M(3) simultaneously. The pole pairs 33CP and 33MP will not be connected to respective terminal pairs 33C(2) and 33M(3) simultaneously, or to respective terminal pairs 33C(3) and 33M(2) simultaneously.

When the selector switch 33 is in the PSTN link connected state, since the pole pair 33CP of the switch section 33C connects between terminal pairs 33C(1) and 33C(2), the telephone interface 30 is in condition to allow incoming calls to be coupled to the communication link 32, where they may be received though the telephone devices 31(n). Similarly, since the pole pair 33MP of the switch section 33M connects between terminal pairs 33M(1) and 33M(2), the telephone interface 30 is in condition to allow incoming calls to be coupled to the modem 34. As will be described below, if an incoming call is not answered by a telephone device, the modem 34, under control of the server's processor, will answer the call, provide an outgoing message, receive an incoming message if the calling party desires to leave one, and provide the incoming message to the server's storage for later retrieval. In addition, when the calling party goes on hook, the modem 34 can go on-hook, thereby to allow another incoming call to be received or to allow a call to be placed through the telephone devices 31(n). Alternatively, if the server is conditioned to provide a

maximum time period for incoming messages, if the calling party's message reaches the maximum time period, the processor can enable the modem 34 to go on-hook to terminate the call.

Similarly, when the selector switch 33 is in the PSTN link connected state, since the pole pair 33CP of the switch section 33C connects between terminal pairs 33C(1) and 33C(2), if a user who wishes to make a call takes a telephone device 31(n) off hook and enters a telephone number, the number will be received by the central office and processed in a conventional manner. Similarly, if the user, through the telephone device's keypad, enter predetermined control codes, which are typically prefixed by the tone provided by, for example, the "star" ("*") key, followed by tones provided by one or more number keys, the central office can be enabled to enable, disable or otherwise control telephony services that are provided to the telephone subscriber by the central office.

It will be appreciated that, when the selector switch 33 is in the PSTN link connected state, control codes entered by the user will also be coupled by the switch section 33M to the modem 34. As will be described below, if the user enters a control code, the modem 34 will notify the processor and, if the user enters a predetermined control codes, the server's processor can enable operations related to the server's call answering services to be provided, which may include, for example, retrieval and playing of previously-recorded messages, deletion of messages, creation of mailboxes, recording of outgoing messages and the like. If the user enters a call answering control code, the processor may enable the selector switch 33 to switch to the PSTN link disconnected state. When the selector switch 33 is in the PSTN link disconnected state, since the pole pair 33CP of the switch section 33C connects between terminal pairs 33C(1) and 33C(3) and the pole pair 33MP of the switch section 33M connects between terminal pairs 33M(1) and 33M(3), the telephone interface 30 connects the

communication link 32 to the modem 34, while disconnecting the PSTN link 23 from the communication link 32 and modem 34. Since the communication link 32 and modem 34 are disconnected from the PSTN link 23, telephone calls that are placed to the PSTN link 23 will not be received by either a telephone device 31(n) connected to the communication link 32 or the modem 34.

However, as is apparent, in the PSTN link disconnected state, the communication link 32 is connected to the modem 34, as well as to the subscriber line interface card 41. In that case, subsequent input provided by the user through the keypad of the respective telephone device 31(n) will be provided only to the modem 34, and, since the communication link 32 and modem 34 are isolated from the PSTN link 23, without the interruption of the dial tone that is provided by the central office on PSTN link 23. In addition, as noted above, if, while the selector switch 33 is in the PSTN link disconnected state, the processor receives a notificatin from the ring detector 37 indicating that the central office has placed a ring signal on the PSTN link 23, which will be the case if another party attempts to place a call to the PSTN link 23 as called party, the ring detector 37 will detect the ringing signal and provide a notification to the server's processor. When that occurs, the server 12 can provide a notification of the call over the communication link 32 to allow the user to determine whether to take the call. It will be appreciated that the ring detector 37 will also provide notifications of incoming calls to the processor while the selector switch is in the PSTN link connected state when the central office provides a ring signal on PSTN link 23, and, in that case the processor can select to make use of one or both of the notifications provided by the ring detector or the notifications provided by the modem 34.

The server's processor can also be enabled to provide at least some of the telephony services (that is, enabling a user to listen to messages that have been recorded by the server 12, manage messages, establish and manage voice mailboxes, and otherwise manage

telephony and other services provided by the server 12) provided thereby when the telephone interface 30 is in the PSTN link connected state in response to a call received over the PSTN link 23, particularly if the incoming call is not answered by a telephony device 31(n). In that case, if the modem 34 receives one or more control codes, it can notify the processor, which can provide the respective services in a manner similar to the manner in which it provides the respective service when requested through a telephony device 31(n). It will be appreciated that the processor may require an authentication code, password or other identifier to be provided by the calling party before the various services will be provided.

As noted above, if an incoming call is received and not answered while the selector switch 33 is in the PSTN link connected state, the modem 34 can answer the call, provide an outgoing message, and receive messages from the calling party and enable them to be stored. In addition, the modem 34 can, under control of a telephony device 31(n), enable messages to be retrieved and provided thereto for playing. The modem 34 is preferably a data/fax/voice modem that can receive digital data, facsimile and voice communications in analog form over the PSTN link 23 and provide a digital DIGITIZED AUDIO OUT signal representing digital data for storage by the server's storage components. Similarly, the modem 34 can receive a digital DIGITIZED AUDIO IN signal representing digital data retrieved from the server's storage components and convert the data to analog audio form for transmission through the switch section 33M. If the selector switch 33 is in the PSTN link connected state, the analog audio signal provided by the modem 34 will be transmitted both over the PSTN link 23 and the communication link 32. On the other hand, if the selector switch is in the PSTN link disconnected state, the analog audio signal provided by the modem 34 will be transmitted over only the communication link 32.

The modem 34 also provides status information to the server's processor components. The status information is provided as a SERIAL DATA signal, which is coupled to the

server's processor through the RS232 converter 36. The status information can notify the processor that a call is being received and the status of the call, including, for example, if the call is answered by one of the telephone devices. In addition, if the telephone subscriber has subscribed to the caller identification service, the status information can provide the caller identification to the processor. The processor can use the status information indicating that a call is being received and the caller identification to, for example, provide a notification to a device 11(n) as described above. The call status information can, for example, include ring information that can be used by the processor to determine whether a telephone device 31(n) has gone off-hook within a predetermined number of rings to answer an incoming call, and, if not, initiate call answering to facilitate recording of a message. The call status information can also include call termination information that, if a message is being recorded, the processor can determine the message has ended.

With this background, operations performed by the telephone interface 30 in connection with receiving a call and in responding to a request from a user through a telephone device 31(n) regarding recorded messages will be described in connection with FIG. 2 and the flow chart depicted in FIG. 3. Generally, in the telephone interface 30, the selector switch 33 will initially be in the PSTN link connected state, with the pole pair 33CP of switch section 33C interconnecting the terminal pairs 33C(1) and 33C(2) and pole pair 33MP of switch section 33M interconnecting the terminal pairs 33M(1) and 33M(2). In that condition, calls placed to the PSTN link 23 by a calling party will be completed by the central office to the PSTN link 23, and, when the modem 34 receives a signal from the switch section 33M, it will initially determine whether the signal is representative of a ring signal from the central office or a control code, the control code comprising a DTMF signal from a telephony device 31(n) for use by the server 12 (step 100). If the modem 34 determines that the signal is a representative of a ring signal from the central office, it will initially provide call status information to the processor indicating that a new call is being

received (step 101). In addition, if the modem 34 receives caller identification information, it can provide the caller identification information to the processor (step 102). After the processor is notified that a new call is being received, it can enable a notification of the call to be displayed or otherwise signaled by one or more of the devices 11(n), along with any received caller identification information (step 103). It will be appreciated that, the telephony devices 31(n) will also receive the ring signal and, if one or more of them have ringers or other devices for providing an audible notification, they may be actuated to produce the audible notification. In addition, the telephony devices 31(n) will also receive the caller identification information, and if one or more of the telephony devices have displays for displaying caller identification information, they may be actuated to display the caller identification information.

The modem 34, for each ring signal received thereby, provides call status information to the processor indicating that a ring signal had been received (step 104). Each time the processor receives call status information from the modem 34 indicating that a ring signal has been received, it will determine whether the number of ring signals received exceeds a predetermined threshold value (step 105), and, if not events return to step 104 to allow the modem to wait for the next ring signal to be received. It will be clear from the following that the predetermined threshold value will correspond to the number of rings at which the server 12 will answer the call and allow the calling party to leave a message.

The modem 34 and processor will sequence through steps 104 and 105 for a number of iterations until either a user answers the call or the processor determines that the number of ring signals that have been received exceeds the predetermined threshold value. If the processor determines that the number of ring signals that have been received exceeds the predetermined threshold value, it proceeds to a sequence in which it enables the modem to provide an outgoing message and for transmission over the PSTN link 23, and to receive a

message and provide a digitized version thereof to storage for later retrieval. In the following, it will be assumed that the server 12 provides a plurality of mailboxes, and that a calling party who wishes to leave a message can identify the mailbox that is to receive the message by depressing a key on the keypad of his or her telephony device (not shown) to provide a DTMF control code. In those operations, the processor will enable the modem to go off-hook to answer the call (step 106) and will enable digital data representing the outgoing message to be retrieved from server storage and provided to the modem 34 as the DIGITIZED AUDIO IN signal (step 107). The modem 34 converts the DIGITIZED AUDIO IN signal to analog form and transmit it to the calling party over the PSTN link 23 (step 108). If the modem 34 receives a DTMF control code identifying the mailbox into which a subsequently received message is to be stored, it provides the control code to the processor (step 109). Thereafter, the calling party can provide a message in analog form, which the modem 34 converts to digital form and couples to the storage as digital DIGITIZED AUDIO OUT signal (step 110). The storage will store the digital information provided thereto in storage locations as determined by the processor (step 111) and the processor will associate the message with the mailbox identified by the control code provided thereto in step 109 (step 112).

When the calling party hangs up (step 113), the modem 34 provides call status information to the processor indicating that the calling party has gone on-hook and the call terminated (step 114), after which the processor can terminate recording of the message, if any, and enable the modem 34 to go to the on-hook condition to terminate the call (step 115). It will be appreciated that the calling party may also go on-hook without leaving a message and even during the ring sequence while the ring signals are being received. In that case, if the calling party hangs up during the ring sequence, before the modem has gone off-hook and answered the call, the modem 34 need merely provide call status information to the processor indicating that the calling party has gone on-hook and otherwise ignore the call. On the other

hand, if the calling party hangs up after the modem 34 has gone off-hook, but without leaving a message, the modem 34 can provide call status information to the processor indicating that the calling party has gone on-hook, and the processor can enable the modem 34 to return to the on-hook condition.

Returning to step 100, if the modem 34 determines in that step that the signal received from the selector switch 33 is a DTMF control code, it will step to a sequence in which the control code is processed. As noted above, the DTMF control code may comprise a control code to control a telephony service provided by the central office, or alternatively it may control a telephony service provided by the server 12, such as retrieving and playing previously-stored messages, recording an outgoing message, and other services as will be apparent to those skilled in the art. Typically, DTMF control codes include a prefix tone corresponding to the telephony device's "star" ("*") and/or "pound" ("#) key followed by one or more tones corresponding to the telephony device's numerical keys. In the following it will be assumed that, to make use of any of the telephony services provided by the server 12, the user will initially enter a DTMF control code that enables the server 12 to, in turn, condition the selector switch 33 to the PSTN link disconnected state, and thereafter enters one or more DTMF control codes to enable the server 12 to provide the particular telephony service or services desired by the user. By providing that the selector switch 33 initially switch from the PSTN link connected state to the PSTN link disconnected state, thereby disconnecting the communication link 32 and the modem 34 from the PSTN link 23, it will be appreciated that the user can make use of the telephony services provided by the server 12 without the possible annoyance of the dial tone provided by the central office on the PSTN link 23, and in addition will further ensure that subsequent DTMF control codes input by a user are not received and erroneously used by the central office. It will be appreciated that the DTMF control code provided by the user to enable the server 12 to condition the

selector switch to the PSTN link disconnected state will preferably not correspond to a DTMF control code used by the central office in providing a telephony service.

In any case, after the modem 34 determines in step 100 that it has received a DTMF control code, it will provide the DTMF control code as CALL STATUS signals to the processor (step 120). The processor will determine whether the DTMF control code is the control code to enable the selector switch 33 to be conditioned to the PSTN link disconnected state (step 121). If the processor makes a positive determination in step 121, it will enable the selector switch 33 to be conditioned to the PSTN link disconnected state (step 122). When the modem 34 receives a subsequent DTMF control code in step 100, which will identify the type of telephony service to be provided by the server 12, it will also provide the DTMF control code to the processor which will determine the type of telephony service to be provided. If the processor determines that the telephony service is the playback of previously recorded messages (step 123), it will determine whether there are any messages to be played (step 124) and, if so, enable them to be retrieved from storage and provided to the modem 34 as the ANALOG AUDIO IN signal (step 125). The modem 34, in turn, will convert the digital message information that it received from storage to analog form for transmission over the communication link 32 (step 126). The user can hear the messages on the telephony device that he or she is using. When the user hangs up (step 127), the modem 34 will provide a notification thereof as the CALL STATUS signal to the processor (step 128), and the processor can, in turn, terminate message retrieval, if all of the messages have not been retrieved (step 129), and, if the selector switch 33 is in the PSTN link disconnected state, enable it to return to the PSTN link connected state (step 130). It will be appreciated that, after the messages have been played and before the user hangs up, the processor may, in the same manner that it provides the previously-recorded messages, provide a message to the user notifying him or her of other options, that is, other telephony services provided by the server 12, and allow him or her to initiate another telephony service prior to hanging up.

Returning to step 124, if the processor determines in that step that there are no messages to be played, it can enable a suitable notification to be provided to the user (step 131). For example, if the notification is to be an audible notification, such as a beep or spoken notification, the processor can enable the digital signal therefor to be provided to the modem 34 as the DIGITIZED AUDIO IN signal, which the modem 34 can convert the digital signal to analog form for transmission over the communication link 32 in the same manner as a previously-recorded message.

It will be appreciated that, if the server 12 provides multiple mailboxes in which messages may be stored, the processor, prior to determining whether there are any messages to be played (reference step 125) can enable a audio notification to be played requesting the identification of the mailbox from which messages are to be played, and allow the user to provide the identification. In those operations, the processor will enable digital data representing the audio notification to be provided to the modem 34 as the DIGITIZED AUDIO IN signal, which the modem 34 can convert the digital signal to analog form for transmission over the communication link 32 in the same manner as a previously-recorded message. The user can use the telephony device's keypad to provide DTMF signals that identify the mailbox from which messages are to be played, and the modem 34 can provide the DTMF tone information to the processor as the CALL STATUS signal. The processor can thereafter use the CALL STATUS signal to determine the mailbox from which messages (if any) are to be retrieved.

Returning to step 123, if the processor determines that the DTMF control code is not one to enable retrieval of messages, it can sequence to step 140 to determine whether the DTMF control code is to enable an outgoing message to be recorded. If the processor makes a positive determination in step 140, it will enable the modem 34 to provide a notification to the user that he or she should begin speaking and thereafter enable the modem to convert

the outgoing message from analog form to digital form and the digitized message to be stored. More specifically, following step 140, the processor will enable the notification that the user should begin speaking to be coupled, in digital form, to the modem 34 (step 141), which converts the notification to analog form for transmission to the user's telephony device 31(n) over the communication link 32 (step 142). Thereafter, as the user provides the outgoing message (step 143), the modem 34 will receive the outgoing message in analog form and convert it to digital form as the DIGITIZED VOICE OUT signal (step 144), which the processor will enable to be stored for future use (step 145). When the user hangs up otherwise terminates the outgoing message (step 146), the modem 34 will provide a notification thereof as the CALL STATUS signal to the processor (step 147), and the processor can, in turn, terminate storage of the digitized outgoing message (step 148), and enable the selector switch 33 to return to the PSTN link connected state and open the make busy relay 37 (step 149). It will be appreciated that, after the outgoing message has terminated and before the user hangs up, the processor may, in the same manner that it provides the previously-recorded messages, provide a message to the user notifying him or her of other options, that is, other telephony services provided by the server 12, and allow him or her to initiate another telephony service prior to hanging up.

Returning to step 140, if the processor determines in that step that the DTMF control code is not to enable an outgoing message to be recorded, it will proceed to step 160 to determine whether the DTMF control code is for another telephony service provided by the server 12, and, if so, it and the elements of the telephone interface 30 will operate to provide the service in a manner similar to that described above, as adjusted for the respective service (step 161), and thereafter the selector switch 33 to will be conditioned to return to the PSTN link connected state and open the make busy relay 37 (step 162). It will be appreciated that, after the service has been provided and before the user hangs up, the processor may, in the same manner that it provides the previously-recorded messages, provide a message to the

user notifying him or her of other options, that is, other telephony services provided by the server 12, and allow him or her to initiate another telephony service prior to hanging up.

It will also be appreciated that, if the processor made a negative determination in step 123, it may require authentication indicia to be provided before permitting steps 127 through 162 to be performed.

If the ring detector 37 receives a ringing signal indicating that an incoming call is being received over the PSTN link 23 (step 170), it can notify the processor (step 171). The processor, in turn, after it receives the notification from the ring detector 37, can determine whether the selector switch 33 is in the PSTN link disconnected state (step 172). If the processor makes a positive determination in step 172, it can provide an audible notification over the communication link 32 that an incoming call is being received (step 173). If the user thereafter enters an appropriate DTMF control code to indicate that he or she wishes to receive the incoming call, the modem 34 can provide a corresponding notification to the processor (step 174), which, in turn, will terminate message retrieval, if all of the messages have not been retrieved (step 175), and enable the selector switch 33 to return to the PSTN link connected state to allow the user to take the call (step 176). As noted above, if the processor makes a negative determination in step 172, it can ignore the notification from the ring detector 37.

The invention provides a number of advantages. In particular, the invention provides a telephone interface 30 for a server 12 in a home area network 10 that interfaces telephony devices in the home to the public switched telephony network (PSTN), and that provides various telephony services. In addition, it does so in such a manner that, if the server 12 malfunctions, or is powered down, since the selector switch's default state is the PSTN link connected state, the telephony devices 31(n) will still be able to access the PSTN through the telephone interface 30.

It will be appreciated that numerous modifications may be made to the telephone interface 30 as described herein. For example, the information represented by the CALL STATUS signal may be provided to the processor using a variety of methodologies. In addition, the telephone interface 30 can be provided without a home network adapter 40 or a ring detector 37. It will be appreciated however, that, if a ring detector 37, or component that serves a similar purpose, is not provided, if a calling party attempts to place a call to the PSTN link while the selector switch 33 is in the PSTN link disconnected state, the user will not be notified if another party attempts to place a call to the PSTN link 23.

As another modificiation, instead of or in addition to a ring detector 37, the telephone interface 30 can be provided with a make busy relay (not separately shown) that, when the processor enables the selector switch 33 to go into the PSTN link disconnected mode, it can also enable the make busy relay to go into a condition that will cause the central office to believe that the PSTN link 23 is open so that the central office will mark the PSTN link 23 as busy. The make busy relay has two states, an open state and a busy state, which can be controlled by the server's processor. The make busy relay can essentially force the PSTN central office to recognize the PSTN link 23 as being in an off-hook condition, even if none of the telephone devices 31(n) are in the off-hook condition, so that the telephone subscriber line will be in the busy condition. The default condition of the make busy relay is the open state, in which the central office will mark the PSTN link 23 as not being busy. In that case, when a calling party attempts to place a call to the PSTN link 23 as the called party, the central office will complete the call. On the other hand, when the processor conditions the make busy relay to the busy condition, the make busy relay will close to condition the PSTN link 23 so as to enable the central office to mark the PSTN link 23 as being busy. In that case, if a calling party attempts to wishes to place a call to the PSTN link 23 as the called party, the central office will not complete the call, but instead will provide a busy tone to the calling party indicating that the line is busy.

In one embodiment, in which the PSTN link 23 comprises two physical wires, when the make busy relay is in the open state, it will provide an open circuit therebetween. On the other hand, when the make busy relay is in the make busy state, it will close a circuit between the two wires in a manner similar to that performed by a telephone device 31(n) when it goes off hook. Since the central office provides a current between the two wires, it can detect when the make busy relay goes into the make busy state by noting the increase in current in the circuit formed between the two wires.

The processor can enable the make busy relay to go into the make busy state when, for example, the selector switch 33 goes into the PSTN link disconnected state. In that case, when a calling party places a call to the PSTN link 23 while, for example, a user is retrieving previously-stored messages, the central office will provide a busy signal to the calling party.

FIG. 4 schematically depicts a portion of a second embodiment of a telephone interface, identified by reference numeral 230. The telephone interface 230 provides an arrangement for providing subscriber loop current that may be necessary to allow certain types of telephony devices to be used with the server 12. Generally, the telephone central office provides a subscriber loop current that may be required by those types of telephony devices to power certain functions, such as ringing, DTMF signal generation, and so forth. Other types of telephony devices may provide their own power, obtained from, for example, electrical batteries, AC power, or the like, and may not need power from the telephone central office for those functions. To facilitate use of types of telephony devices that do require power from a central office, the telephone interface 230 also provides an arrangement for providing subscriber loop current to those telephony devices, illustratively, telephony device 231.

With reference to FIG. 4, the telephone interface 230 also includes a selector switch 233 for selectively connecting the telephony device 231 and a modem 234 to, or

disconnecting them from, the PSTN link 23. As noted above, the PSTN link 23, communication link 32, and so forth, depicted in FIG. 2 actually comprise two wires, and in FIG. 4 the wires comprising the respective links 23, 232, and so forth, are depicted explicitly and distinguished by indices "a" and "b". In addition, as noted above, the selector switch 33 is a double pole-double throw switch, and in FIG. 4 the respective double terminals and poles of the respective switches 233C and 233M are depicted explicitly and distinguished by indices "a" and "b". The telephone interface 230 is also provided with an arrangement 240 that provides subscriber loop current, including current sources 241 and 242 and a capacitor 243. Current source 241 is connected to terminal 233C(3)(a) of switch 233C, and current source 242 is connected to terminal 233M(3)(a) of switch 233M. Capactor 243 is connected between terminals 233C(3)(b) and 233M(3)(b) of switches 233C and 233M and provides an AC (alternating current) short for audio frequencies. Terminals 233C(3)(b) and 233M(3)(b) are connected together. Current source 241 is connected to a positive voltage source to provide current, and current source 242 is connected to a negative voltage source to sink current. When, as depicted in FIG. 4, the selector switch 233 is in the PSTN link disconnected state, the current sources 241 and 242 provide subscriber loop current to the loop consisting of terminal 233C(3)(a), pole 233CP(a), terminal 233C(1)(a), communication link wire 232(a), telephony device 231, communication link wire 232(b), terminal 233C(1)(b) pole 233CP(b), terminal 233C(3)(b), terminal 233M(3)(b), pole 233MP(b), terminal 233M(1)(b), modem 234, terminal 233M(1)(a), pole 233MP(a), and terminal 233M(3)(a). Accordingly, when the selector switch 233 is in the PSTN link disconnected state, the switch provides a loop to which the loop current arrangement 240 can provide current.

The foregoing description has been limited to a specific embodiment of this invention. It will be apparent, however, that various variations and modifications may be made to the invention, with the attainment of some or all of the advantages of the invention. It is the

object of the appended claims to cover these and such other variations and modifications as come within the true spirit and scope of the invention.

What is claimed as new and desired to be secured by Letters Patent of the United States is: